Office of Operating Experience Analysis, EH-33 • U.S. Department of Energy • Washington, D.C. 20585

OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

May 21 - May 27, 1999

Summary 99-21

Operating Experience Weekly Summary 99-21

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EVENTS

1. ELECTRICIANS INJURED WHILE CONDUCTING TESTS IN A SUBSTATION

On May 19, 1999, at the Western Area Power Administration, three electricians suffered injuries while performing electrical testing at a substation in Hayden, Colorado. An ambulance transported all three electricians to a hospital. One of the electricians suffered second- and third-degree burns, the second electrician was knocked from a ladder and injured his neck, and the third electrician received a minor burn to his shoulder. Doctors have downgraded the condition of the first electrician from serious to fair and will soon release him from the hospital. The other two electricians, who sustained minor injuries, were treated and released the day of the accident. The electricians were conducting a power-factor insulation test (commonly referred to as a Doble™ test) on a circuit breaker when an explosion occurred. The test determines the insulating value of a piece of equipment and is performed with the equipment de-energized. Electricians use the Doble™ test equipment to induce a voltage (as high as 10,000 V ac) into the equipment being tested while they take conductivity measurements to determine how much current is leaking past an insulator. A Type B accident investigation team was formed to determine the cause of this event. Investigators believe the burns were not contact burns but resulted from an electrical flash. An electrical clearance (lockout/tagout) was in place on the bay the electricians were working in at the time of the incident. OEAF engineers will follow this event and will provide additional information as it becomes available.

KEYWORDS: burn, electrical safety, fall, injury, substation, test

FUNCTIONAL AREAS: Electrical Maintenance

2. BACKHOE HITS AND RUPTURES A NATURAL GAS LINE

On May 24, 1999, the safety and health manager at the Federal Energy Technology Center in Bruceton, Pennsylvania, reported that a subcontractor backhoe operator had punctured a buried 6-in., 55-psi natural gas line while excavating for the installation of a drain pipe for an electrical vault on April 6, 1999. An electrician working in the area heard the escaping gas and called the security emergency phone number. Security emergency personnel ordered personnel in nearby buildings to evacuate the area. The subcontractor failed to follow procedures that required him to locate the pipeline, mark its location before digging, and use hand tools to locate the pipeline. Safety personnel shut valves supplying gas to the punctured section of pipe. Although no injuries occurred and the gas did not ignite, ruptures of active gas lines have the potential to cause injury, fatalities, equipment damage, or process interruptions. (ORPS Report HQ--GOPE-FETC-1999-0004)

Investigators determined that the subcontractor had utility maps for underground utilities and was using a project-wide digging permit. The DOE contractor supervisor thought that there was more distance between the excavation and the gas pipeline. The gas leak allowed natural gas to permeate several buildings, causing some building toxic gas monitors to alarm. Safety personnel monitored gas concentrations and allowed personnel to re-enter buildings within 45 minutes of the event. The facility manager is considering corrective actions that include changing the practice of issuing generic project-wide digging permits to issuing digging permits more specific to the planned activities.

NFS has reported other gas line ruptures during excavation work in the Weekly Summary. The following examples also include the failure to hand excavate.

- Weekly Summary 99-08 reported that a construction subcontractor at the National Renewable Energy Laboratory operating a track-hoe struck and ruptured a 2-in. natural gas distribution line. The subcontractor immediately stopped work, shut down his equipment, and evacuated the work area. He had failed to follow a project manager's instructions as to the excavation boundaries and was working in an area that should have been excavated by hand. (ORPS Report CH-NA-NREL-NREL-1999-0001)

- Weekly Summary 98-34 reported that a trenching machine operator struck and severed a 1-in. natural gas pipeline at the Los Alamos National Laboratory. Investigators determined that the construction contractor did not carry out the work in accordance with contract provisions because he did not maintain a red-line drawing at the work site that showed underground utilities relative to site benchmarks. Also, he did not direct workers to excavate by hand within 5 ft of utilities and did not consult site utility locator personnel before excavation began, as required by the activity hazard analysis. (ORPS Report ALO--LA-LANL-ADOADMIN-1998-0005)

Natural gas explosions can cause significant damage and loss of life. On December 11, 1998, in St. Cloud, Minnesota, workers attempting to lay a fiber optic cable cut a gas main, resulting in an explosion. The blast leveled three buildings, killed four people, and injured ten others. When utilities are known to be near planned excavations, pre-job planning should address the location and accessibility of means to interrupt the energy source, such as shut-off valves or breakers. Construction supervisors and project managers should review the following documents related to excavation activities.

- OSHA 29 CFR 1926, *Safety and Health Regulations for Construction,* subparts .651(b) and .651(a)(3), make employers responsible for identifying underground hazards near a work area. 29 CFR 1926.965(c) requires that work must be conducted in a manner to avoid damage to underground facilities. Similarly, work must be performed in a manner that provides protection to the workers.

- DOE/EH-0541, Safety Notice 96-06, *Underground Utilities Detection and Excavation*, provides descriptions of excavation events, an overview of current technology for underground utility detection, specific recommendations for improving site utilities detection and excavation programs, and information on innovative practices at DOE facilities. It states that a central coordinator should not only assist in identifying underground utilities but should also record the findings. It can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety notices are also available on the OEAF home page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

Other sources for excavation safety information include the following.

- Hanford Lessons Learned No. 1998-RL-HNF-0026, available at http//www.hanford.gov/lessons/sitell/1998/199826.htm. This document provides the lessons learned from two excavation occurrences at Hanford and describes the bases for the Hanford excavation safety program.

- The OSHA technical link for trenching and excavation, available at http://www.osha-slc.gov/SLTC/trenchingexcavation/index.html.

KEYWORDS: construction, excavation, gas line, underground, utility

FUNCTIONAL AREAS: Construction, Industrial Safety

3. EXPIRATION DATE EXCEEDED FOR EMERGENCY RESPONSE PROTECTIVE EQUIPMENT

On May 13, 1999, at the West Valley Site, emergency response personnel discovered that the personal protective suits worn by the hazardous materials (HAZMAT) response team were older than the vendor-recommended 3-year life span from the date of manufacture stamped inside each suit. HAZMAT personnel were inspecting the suits in preparation for a training course when they discovered that the shelf life of the suits had been exceeded. They initiated an inventory of all the protective suits to determine the availability of usable suits and found that all the suits on site had exceeded their expiration date. This event is significant because using personal protective equipment whose integrity may be degraded can expose workers to hazardous substances that could cause serious injury. (ORPS Report OH-WV-WVNS-WVNSGEN-1999-0001)

Vapors, gases, and particulates from hazardous substance response activities place emergency response personnel at risk. For this reason, response personnel must wear appropriate personal protective clothing and equipment whenever they are near a hazardous site. The expired protective suits were disposable, one-time-use, Level A and Level B personal protective equipment. Level A and Level B are the two highest levels of protective clothing. Level A protection is required when the greatest potential for exposure to hazards exists and when the greatest level of skin, respiratory, and eye protection is required. Examples of Level A clothing include a totally encapsulated chemical- and vapor-protective suit and inner and outer chemical-resistant gloves or a disposable protective suit, gloves, and boots. Level B protection is worn in circumstances also requiring the highest level of respiratory protection but a lesser level of skin protection. Level B protective clothing includes inner and outer chemical-resistant gloves and boots, face shield, hooded chemical-resistant clothing, and coveralls. Both levels of protection require a positive-pressure, full face-piece, self-contained breathing apparatus (SCBA) or a positive-pressure supplied air respirator with escape SCBA.

Investigators determined that the Level A suits were procured in 1991 and 1993 and that the Level B suits were procured in 1994. Collectively, the suits were between 5 and 8 years old, with the shelf life of the most recent suit having expired in 1997. They also determined that there was no program or surveillance that monitored the suits' expiration dates, and that the Level A suits had been used when emergency personnel responded to a small acid spill in a confined area in 1997. The HAZMAT team obtained Level A and B suits on loan from the local county emergency management agency and then procured new suits from a protective equipment vendor. Although the new suits do not have an expiration date, emergency response personnel have initiated a program that will inventory and inspect emergency response equipment and clothing semiannually. The program will have specific criteria to track items whose usefulness is limited by their shelf life.

Emergency response supervisors should ensure that there is a system or program in place to periodically verify that emergency response equipment used to protect personnel against exposure to hazardous substances or used to mitigate or decontaminate a hazardous material event is still usable. Emergency response equipment that is nearing the end of its useful life should be replaced in sufficient time to ensure new equipment is placed into service before the expiration date of the older equipment. Facilities with a procurement process that includes a shelf-life-monitoring program should consider having emergency response equipment ordered and tracked through that program to minimize administrative costs. High-cost items with limited shelf lives should be replaced over a span of time to minimize the impact on a facility's budget. The replacement cost for the expired protective suits in this event was approximately $3,700.

Although emergency response suits and equipment must be immediately available, they are typically stored under special conditions and have unique requirements for their care and use. Some guidance is provided by DOE Order 4330.4B, *Maintenance Management Program*. It states: "A shelf-life control program should be provided for stores items that are important to safe and reliable facility operation. Various items with finite storage lifetimes…should be tracked so that stock that has exceeded its shelf life is not issued. Any material reaching the end of its shelf life should receive proper engineering analysis with appropriate vendor input to extend its storage lifetime or be disposed of and reordered. The reorder date should consider material lead times so that sufficient material with good shelf life is ready for issue."

29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*, covers "emergency response operations for the release of, or the substantial threat of release of, hazardous substances without regard to the location of the hazard." Section (k)(5)(i) states that protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained, or replaced as needed to maintain their effectiveness. Appendix B, "General Description and Discussion of the Levels of Protection and Protective Gear," provides guidelines for the selection of appropriate personal protective equipment and notes that the National Fire Protection Association (NFPA) has developed standards for chemical protective clothing.

- NFPA 1991, *Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies*, specifies minimum requirements for the design, performance, testing, and certification of vapor-protective suits for emergency responders to hazardous materials incidents for protection from chemical vapor, liquid splash, and particulate exposures.

- NFPA 1992, *Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies*, specifies similar requirements for liquid-splash-protective suits for protection from specified chemical liquid splash exposures.

KEYWORDS: air-supplied suit, exposure control, hazardous material, industrial safety, personal protective equipment

FUNCTIONAL AREAS: Industrial Safety

4. FLASHBACK IN OXY-GASOLINE CUTTING SYSTEM RUPTURES OXYGEN LINE

On May 19, 1999, at the Hanford Site Inactive Facilities Surveillance and Maintenance Facility, a flashback occurred in the oxygen line for an oxy-gasoline cutting system when a decommissioning and decontamination (D&D) worker ignited the torch. The flashback ruptured and separated the oxygen hose at a point approximately 10 ft from the D&D worker and 50 ft from the gasoline tank. The worker was cutting on the north side of a 6-ft diameter, 5/8-in. steel pipe, and the rupture occurred on the south side of the pipe. A D&D worker who was on the south side of the pipe heard a loud crack and observed a road-flare-sized flame at the rupture. He quickly shut off the oxygen supply. No other personnel were within 10 ft of the burst, and no personnel were injured; however, a rupture closer to the D&D worker using the torch could have caused burns or other injury. (ORPS Report RL--BHI-IFSM-1999-0004)

The oxy-gasoline cutting system (Figure 4-1) consists of a standard oxygen cylinder, a pressurized 3-gal tank of unleaded gasoline, hoses, and a cutting torch. The tank delivers gasoline to the torch in liquid form, where it vaporizes and mixes with oxygen at the torch tip. Flashbacks on the fuel side are not possible because of the liquid state in the line. Also, a quick-close, high-flow valve at the gasoline tank immediately shuts off fuel if a line ruptures. The oxy-gasoline system offers several advantages over the standard oxy-acetylene cutting system, including safety, economy in fuel and labor-hours, longer tip life, faster burning, and little or no slag production.

Figure 4-1. Oxy-Gasoline Cutting System

The D&D workers immediately stopped work and notified their job supervisor. Investigators consulted the manufacturer's technical manual. The manual recognizes that backflow of fuel into the oxygen line is possible under some circumstances. It recommends purging the oxygen line before igniting the torch and installing an additional flashback arrestor in the oxygen line at the torch. A field engineer received the same recommendations orally from a representative of the manufacturer, who also said that an incomplete purge of the oxygen line could cause a flashback. The system in use already had a flashback arrestor at the oxygen cylinder, as required by the manufacturer. Facility personnel installed a flashback arrestor on the torch and tested the system successfully. Additional corrective actions include incorporating the additional flashback arrestor into training and preparing a lessons learned bulletin for distribution to potentially affected sites.

This occurrence has been posted on the DOE Lessons Learned List Server. Visit http://www.tis.eh.doe.gov/ll/listserv.html for information on Lessons Learned List Server membership and access. Additional information on the oxy-gasoline system is available on the Web at http://www.fernald.gov/Technology%20Programs/lstd/oxy.htm, which describes the results of a technology demonstration conducted in 1996 by the DOE Fernald Environmental Management Project and Fluor Daniel Fernald.

KEYWORDS: cutting torch, fire, flashback, oxygen, rupture

FUNCTIONAL AREAS: Decontamination and Decommissioning, Fire Protection, Lessons Learned

5. RESPIRATOR BLOWER MOTORS MALFUNCTION

On March 30, 1999, at the Rocky Flats Site Environmental Technology Site, ten new Mine Safety Appliances (MSA) OptimAir 6A powered air purifying respirators (PAPR) with belt-mounted blowers malfunctioned during maintenance work. The malfunctions were excessive vibration, variable fan speeds, excessive noise, and, in two cases, complete shutdown. Malfunctions of PAPR blower motors can result in decreased respirator protection factors and can increase the risk of exposing the wearer to hazardous breathing air. (DOE Lessons Listserver Identifier KH-99-057.CA)

The site respiratory protection program administrator (RPPA) conducted a random evaluation of 37 new OptimAir 6A PAPR blowers and discovered that approximately 40 percent of the blowers evaluated had excessive vibration and/or varied flow rates. Rocky Flats personnel sent 21 malfunctioning OptimAir 6A blower modules to MSA for evaluation. MSA evaluated five of the modules. On April 22, 1999, MSA wrote a letter to the site RPPA stating that “the low flow and noise was caused by a loose impeller and that the impeller in each unit had loosened from the motor shaft causing the low flow.” In addition, MSA stated that 18 of the 21 blower modules returned to MSA had been manufactured in March 1998.

MSA determined that the impellers were loose because of “improper adhesives used in the assembly of the impeller to the motor shaft during that time.” Figure 5-1 shows a worker wearing an MSA OptimAir 6A PAPR.

Figure 5-1. MSA OptimAir 6A PAPR
(Courtesy Mine Safety Appliances Company)

MSA indicated that the defective units will be replaced under warranty, but they did not believe that a safety notice to users was warranted. Rocky Flats managers are currently evaluating options with the remaining units they have on site. Site personnel continue to use MSA OptimAir mask-mounted PAPRs.

Facility managers and personnel in charge of respiratory protection programs should check their inventories for these respirators and verify their correct operation. Personnel who wear respirators should ensure that they understand and implement the correct methods of wearing, operating, and checking their respirators. DOE/EH-0256T, *Radiological Control Manual*, 29 CFR 1910.134, *Respiratory Protection,* and ANSI Z88.2-1992, *Respiratory Protection*, discuss equipment and requirements of respiratory protection programs and provide additional references.

KEYWORDS: industrial hygiene, radiation protection, respirator

FUNCTIONAL AREAS: Industrial Safety, Radiation Protection

6. NYLON SLING FAILS DURING COMPONENT LIFTING

On May 20, 1999, at the Argonne National Laboratory—East CP-5 Reactor, riggers were attempting to remove a 400-lb beam port casting from the face of a concrete monolith (biological shield) using the reactor building polar crane when a nylon lifting sling broke. The recoil caused the crane block to swing over, although it did not hit the reactor monolith. The riggers had believed the casting was loose from the monolith and attempted three times to remove it. The sling broke during the third attempt. Although the riggers and the crane operator thought that the casting was free from the monolith, they should have realized that it wasn't after the first attempted lift failed. There were no injuries as a result of this event but the failure of rigging under load is dangerous because of missile hazards or dropped loads. (ORPS Report CH-AA-ANLE-ANLEER-1999-0008)

The riggers were tasked with removing the beam port casting from the monolith as part of CP-5 reactor decontamination and decommissioning activities. The beam port casting is a metal pipe-like structure having a wall thickness of about 0.5 in., a diameter of about 3 ft, and a length of about 18 in. The casting had been supported from underneath by metal supports; these supports were unattached at the time of the attempted lift. At the time of initial construction, the concrete (which is the monolith) had been poured around the casting. The riggers and crane operator believed the casting was loose and could be lifted out from the concrete, because the operator of a machine that had smashed the concrete around the casting claimed that he had seen the casting move. They therefore rigged the nylon sling to the casting and attached it to the polar crane. On the first two attempts to pull the casting out, the casting moved only slightly. Based on this movement, the crane operator was attempting the third lift, when the sling failed.

Investigators determined that the riggers inspected the nylon sling before use and considered it serviceable. An inspection of the sling after the incident showed that it had been cut, not overloaded (it was rated for 11,000 lb). The riggers did not inspect the beam port casting before the lift, but an inspection after the incident revealed that the casting had sharp edges that could have cut the sling. Investigators also determined that the riggers did not attach a load cell to the crane while attempting to remove the beam port casting.

Operators took the crane out of service. They performed an inspection and operational check of the crane and found no damage to the crane. All crane operators and riggers were retrained in the proper selection, inspection, and placement of rigging. The training also covered two requirements: (1) verify that a component is loose before attempting to lift it and (2) use a load cell to indicate the lifting force being applied.

NFS has reported other sling failures in the Weekly Summary. Some examples follow.

- Weekly Summary 98-05 reported that a nylon sling failed while subcontractor riggers used a front-end loader to lift a 3,771-lb, 10-ft diameter by 16-ft long corrugated steel pipe at the Fernald Environmental Management Project. The riggers had cut two holes 180 degrees apart at one end of the pipe so they could attach shackles to the pipe. Investigators believe that the sharp edge of the corrugated pipe cut the sling as riggers lifted the pipe from a horizontal position to a vertical position. They also determined that the sling capacity did not meet the requirements specified in the lift plan. There were no injuries to personnel or damage to equipment as a result of the sling failure. (ORPS Report OH-FN-FDF-FEMP-1998-0001)

- Weekly Summary 92-31 reported that a worker was fatally injured at the Oak Ridge K-25 Site when a tie-down strap being used as a lifting strap failed while lifting a 6,800-gal storage tank. (ORPS Report ORO--MMES-K25GENLAN-1992-0094)

These events illustrate the importance of ensuring that the rigging is not exposed to sharp edges and that its rating is not exceeded. Also, if during the lift the load does not move, then the lift should be stopped and the load checked for obstructions or interference before proceeding. DOE-STD-1090-99, *Hoisting and Rigging*, provides guidance for hoisting and rigging and identifies related codes, standards, and regulations. The following guidance applies to this event.

- Section 11.3.5, “Synthetic-Web Slings,” specifies requirements for nylon slings. The section states that despite their inherent toughness, synthetic-web slings can be cut by repeated use around sharp-cornered objects and will eventually show signs of abrasion when repeatedly used to hoist rough-surfaced products. Section 11.3.5.3, “Operation,” states that personnel should protect slings from being cut by sharp corners, sharp edges, and highly abrasive surfaces.

- Section 12.8, “Load-Indicating Devices,” provides guidance for the use of load-indicating devices or load cells. It recommends using load-indicating devices where the equipment/tackle configuration could bind the load, which would place a greater stress on the hoist or tackle than would be expected from the apparent hook load.

KEYWORDS: hoisting and rigging, industrial safety, lift, sling

FUNCTIONAL AREAS: Decontamination and Decommissioning, Hoisting and Rigging, Industrial Safety

7. INADEQUATE CONTROL OF STARTUP TESTING

On May 12, 1999, at the Savannah River F-Area Tank Farm, a startup testing crew preparing to test the installation of a new continuous air monitor (CAM) on a waste-tank purge ventilation line almost operated the tank ventilation system with a failed high-efficiency particulate air (HEPA) filter installed. Following a few days of prerequisite and test procedure steps, a startup test engineer asked the shift manager for permission to proceed with startup testing of two CAM installations. The shift manager mentioned that the installed HEPA filter for the tank had failed its dioctyl phthalate (DOP) test and that a portable ventilation system with a HEPA filter had been installed until the failed filter could be replaced. However, the startup test crew had removed the portable ventilation system in the course of performing the prerequisite steps. The limitations posed by the failed HEPA filter had not been identified during a pre-job briefing for the startup testing. The tank contains approximately 338,000 gal of high-level radioactive waste. If the ventilation system had been operated, it could have resulted in reduced filtration of the tank airspace exhausted to the stack. (ORPS Report SR--WSRC-FTANK-1999-0013)

Startup testing was in progress for the new CAMs that had been installed on the waste-tank purge lines for tank 5 and tank 6. On May 5, operators performed the prerequisite steps in the startup test procedure for tank 6. They performed a step in the procedure that required the removal of a flexible duct hose (elephant trunk) from the exhaust stack. That hose was part of the portable ventilation system used in lieu of the installed failed HEPA. They also installed a temporary air sampler. On May 6, operators started and operated the tank 6 purge CAM for approximately 30 min. After they secured the CAM, they detected no activity on the temporary air sampler's filter paper. On May 12, the startup engineer learned that testing of tank 6 could not continue because of the failed HEPA filter. Operators reinstalled the portable ventilation unit, including the flexible duct hose. The shift manager directed the startup test group to place all current CAM startup test procedures on hold.

The facility manager conducted a critique of the event. Critique members determined that the pre-job briefing had been inadequate because not all personnel involved with testing were present and the briefing had focused on the startup test procedure associated with tank 5 and not tank 6, which was impacted by the failed HEPA and temporary ventilation system. They also identified the following additional conduct of operations deficiencies.

- A test engineer failed to read a procedure step verbatim and an operator failed to repeat it back to the engineer who was reading the procedure step, resulting in the startup of the wrong fan. The engineer directed him to start the tank purge exhaust fan but the operator thought he meant the fan motor for the CAM. In this way, a step was signed off on the test that was not actually performed.

- One operator failed to report a change in equipment status to the control room, so the removal of the temporary ventilation system was not logged.

The facility manager determined the cause of this event was inadequate control of startup activities. Corrective actions include (1) reviewing the tank 6 startup test procedure for possible changes, including a more thorough check of system status before testing; (2) reviewing the procedures for conducting pre-job briefings; (3) reemphasizing the importance of using the formal unique component nomenclature along with repeat-backs during the performance of procedures; and (4) ensuring that equipment/system status changes are reported to the control room and logged.

NFS reported on an event in Weekly Summary 99-11 that involved similar conduct of operations deficiencies. Operators at the Idaho Nuclear Technology and Engineering Center Fuel Storage Area failed to store a fuel assembly in a storage port that was specified on a fuel receipt-and-transfer record form during cask unloading operations. Investigators determined that two different crews of operators, with a common supervisor, had performed the cask unloading operations. The second crew mistakenly used a fuel receipt-and-transfer record form that was intended for a different fuel unit, which was also being transferred. The facility manager determined that inadequate pre-job briefing, inadequate turnover of responsibilities, and poor communications all contributed to this event. Specifically, (1) the second crew received an inadequate pre-job briefing and shift turnover when crews were changed in the middle of the cask unloading operation, (2) repeat-backs to verify the actual port numbers before placing the fuel in a storage port were inadequate, and (3) operations personnel used the wrong fuel handling document because fuel handling documents for several different pieces of fuel were present in the area. (ORPS Report ID--LITC-FUELRCSTR-1999-0005)

These events underscore the importance of maintaining adequate control of work activities. Facility managers and supervisors should ensure that pre-job briefings are adequate. Pre-job briefings are typically the last opportunity to discuss the task and communicate important information on personnel safety and work-related hazards to the workers. Also, communication between a procedure reader and performer should include repeat-backs of information. Communication can also be enhanced if the instruction is followed by a confirmation of completion.

- DOE O 5480.19, *Guidelines for the Conduct of Operations Requirements for DOE Facilities*, provides guidance on sound operating practices. It states that accurate communications are essential for safe and efficient facility operation. Chapter VIII, "Control of Equipment and System Status," states that the operating shift should know the status of equipment and systems, and it discusses the communications needed to maintain proper configuration control.

- DOE-STD-1031-92, *Guide to Good Practices for Communications*, provides guidance for repeat-back and confirmation in section 4.1, "Oral Instructions and Informational Communications."

KEYWORDS: communication, operations, pre-job briefing, procedures, startup, test

FUNCTIONAL AREAS: Operations, Procedures, Startup

8. INSIGHT FROM NRC INSPECTION OF CIRCUIT BREAKER MAINTENANCE PROGRAMS

This week OEAF engineers reviewed Nuclear Regulatory Commission (NRC) Information Notice 99-13, *Insights from NRC Inspections of Low- and Medium-Voltage Circuit Breaker Maintenance Programs*. The NRC issued the information notice on April 29, 1999, to summarize observations made and insights gained during inspections of circuit breaker maintenance programs at eight nuclear power plant sites in 1998. The inspections were conducted because of concerns about the reliability of safety-related medium-voltage (4 kV to 15 kV) and low-voltage (600 V and below) power circuit breakers. The inspections confirmed that the programs were generally adequate. However, observations at several of the inspected plants indicate that licensee programs have several areas in common that might warrant improvement. In addition, in a few instances certain aspects of the programs did not meet NRC requirements, and violations were cited. NRC developed the notice so that all licensees can take advantage of the insights gained from the inspections when they are considering improvements to their circuit breaker maintenance programs. (NRC Information Notice 99-13)

In the notification, NRC categorized the significant observations from its inspections as follows: (1) general programmatic issues, (2) preventive maintenance, (3) licensee/vendor interface, (4) control voltage calculations, and (5) operating experience review.

GENERAL PROGRAMMATIC ISSUES

Licensee preventive maintenance procedures and practices did not always reflect all applicable vendor recommendations or industry operating experience, and when licensees deviated from such recommendations and operating experience they often had no documented basis or rationale. Such deviations should have a sound engineering basis and should be performed in consultation with the vendor, when possible, to ensure that valuable vendor information is not overlooked. Storage, shelf life, environment, segregation, and issuance of lubricants and cleaning materials were not well controlled. Some licensees had not identified shelf lives for circuit breaker lubricants and cleaning agents or solvents. Individual breakers at some plants either did not come with or were not given unique identifiers by the licensee. Some licensees were not aware that group or series identifiers, such as shop order numbers, were not unique. Also, some licensees did not record either the breaker serial number (when one existed) or the cubicle number in maintenance records to allow for tracking of breaker location, performance, and maintenance history.

At most plants, the racking of breakers in and out of the cubicle (and local operation when required) was the job of operations department personnel rather than circuit breaker maintenance personnel. However, operations department training and/or procedures did not always cover breaker position verification or functional testing in the connected position (closing the breaker and running load equipment, when permitted by plant conditions). If operations department personnel are trained to verify proper indications, to verify recharging of the closing spring, to restore all electrical and mechanical interfaces and interlocks, and to cycle the breaker after it is racked in, there might be fewer failures to close on demand.

PREVENTIVE MAINTENANCE

Licensees did not always perform preventive maintenance as frequently as recommended by the original equipment manufacturer, and they had no documented justification for deviating from that recommended frequency. Maintenance procedures sometimes did not cover inspection for specific problems identified in industry operating experience. Some licensees said that they covered these items in training, but the items in question were seldom explicitly addressed in lesson plans.

LICENSEE/VENDOR INTERFACE

Inspections revealed that licensees often did not keep circuit breaker and switchgear vendor manuals current, and programs aimed at periodically contacting vendors were ineffective in obtaining revisions or updates to vendor manuals or other pertinent technical information. Some licensees identified areas in which vendor interface programs could be improved. These areas included the following.

- Periodic reviews of plant equipment to ensure that lists of key safety-related equipment are current
- Establishment of organizational and procedural interfaces and links to ensure that vendor interface personnel are kept informed of equipment changes or modifications
- Establishment of personal contact with the appropriate vendor personnel
- Substantial involvement of personnel who are technically knowledgeable about the equipment
- Periodic comprehensive reconciliation with the vendor of lists of equipment and related technical publications or documentation

CONTROL VOLTAGE CALCULATIONS

Inspections revealed that a few licensees had not performed the circuit breaker control voltage calculations based on as-built systems. In some cases where calculations were performed, inspectors identified several discrepancies.

These discrepancies included the following.

- Failing to start with the minimum battery voltage
- Using an incorrect minimum battery voltage that did not take into account loading, state of discharge, and/or aging factors
- Using incorrect current paths, cable lengths, conductor sizes, and/or ohms/foot values to determine overall cable resistance
- Calculating cable conductor resistance using ambient temperature values but neglecting the temperature rise caused by heat from surrounding cables in a raceway or without having data to justify the nonconservative lower temperature assumption
- Using incorrect loading values in the final determinations of voltage drops.

OPERATING EXPERIENCE REVIEW

The review of operating experience documents related to low- and medium-voltage circuit breakers by some licensees was weak. These documents included NRC information notices; Institute for Nuclear Power Operations SEE-IN documents or Nuclear Network reports; and vendor information, such as service information letters, technical bulletins, or service advisory letters. The inspections revealed some licensees, because of narrowly focused and/or superficial reviews and insufficient involvement by technically knowledgeable personnel, had erroneously determined that industry operating experience information was not applicable. A licensee often did not recognize generic problems on its breakers because the breakers did not have exactly the same model designation as the breaker referred to in the information notice or the vendor technical bulletin. Some licensees had also erroneously determined that up to one-third of the 62 NRC information notices and bulletins about problems with low- and medium-voltage power circuit breakers were not applicable to their plants.

This notice identifies deficiencies and issues that could be applicable throughout the DOE complex. Electrical maintenance managers at DOE sites should ensure that their circuit breaker maintenance programs do the following: (1) periodically review preventive maintenance procedures for accuracy and completeness, (2) incorporate vender recommendations and practices, (3) keep vendor manuals current, (4) review DOE and industry operating experience for applicability to their equipment, and (5) incorporate lessons learned.

KEYWORDS: circuit breaker, electrical maintenance, operating experience

FUNCTIONAL AREAS: Electrical Maintenance, Operating Experience, Lessons Learned

OEAF FOLLOW-UP ACTIVITY

1. OPERATING EXPERIENCE WEEKLY SUMMARY TO BE AVAILABLE VIA E-MAIL

The Office of Nuclear and Facility Safety will soon be able to send a .pdf version of the OEWS directly to your e-mail. Here are just a few benefits you will see when you have an electronic copy sent “straight to your desktop.”

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